The Place of Buckeye Knoll (41VT98) Material With Respect to Bioarchaeology

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ABSTRACT

This document provides a technical overview of the scientific importance of human skeletal remains from the Buckeye Knoll Site (41VT98), Victoria, Texas. The materials were recovered by Coastal Environments, Inc. under contract to the Corps of Engineers as part of Section 106 archaeological investigations undertaken in conjunction with improvements to the Channel to Victoria. A brief overview of the importance of osteological inventory and types of information obtained is presented.

To assess the scientific importance and significance of the Buckeye Knoll materials, several types of information are used to place the materials within a broad national, continental and even international perspective. These assessments are based on a series of Florida State University, Department of Anthropology databases developed over the last 20 years. They include information on North American skeletal sample size, chronological distribution, metric and nonmetric features - all useful for comparative purposes. Some of these databases also contain information for global samples from Europe to Japan and Australia and South America. An additional perspective on the material's scientific importance and uniqueness is derived from a consideration of the geographic and chronological distribution of known skeletal samples from the state of Texas (primarily based on a series of previous Corps funded studies).

The simplest facts of this comparative perspective include the following salient observations: samples of this antiquity are rare; samples of this size and antiquity (in excess of 6,000 years before present) are even rarer; of the over 60,000 individuals in these various databases there are fewer than 800 individual of this antiquity in North America; the Buckeye Knoll materials (specifically the Early Archaic samples) constitute the third largest sample of this antiquity in North America. The majority of Texas samples have received virtually no inventory or detailed analysis further emphasizing the potential contribution of the Buckeye Knoll materials.

In summary, the scientific information which could be obtained from the study of the Buckeye Knoll materials is extremely important and provides a virtually unique opportunity not only for an understanding of Texas bioarchaeological adaptation but for our understanding of North American and New World human adaptation. The size of the sample coupled with their antiquity emphasizes the importance of the Buckeye Knoll materials.

OSTEOLOGICAL METHODS AND UTILITY

Assessment of site and material significance and the potential contribution of a sample to our understanding of North American archaeology requires a consideration of site integrity, site context, and its relationship with other locally, regionally and nationally significant samples. As part of this process, we have compiled several comparative skeletal and dental databases and have initiated a compilation of bibliographic references of previous analyses on Texas skeletal material. The first step in this report will be to assess the broader context of Buckeye Knoll's potential scientific contribution. We will then consider Buckeye Knoll's potential for local, regional and national contribution for understanding biocultural adaptation in early Native American populations living along the Texas Gulf Coast. First-hand, in situ observation of the skeletal material indicates most of the remains are incomplete and fragmentary. Nonetheless, the collection, as a whole, will provide both metric and nonmetric skeletal and dental observations that are useful in a wide variety of bioarchaeological comparisons. According to the preliminary field inventory, the Buckeye Knoll sample consists of 75 burials with an estimated minimum of 80 individuals. Two burials are definitely Late Archaic (ca. 2500 BP), four additional burials 'may' be Late Archaic and the remaining 69 burials are definitely or probably Early Archaic (ca. 6500 BP) (all dates mentioned here are uncorrected radiocarbon dates).

Human skeletal material and the information it provides has long been recognized as one of the most important components of the archaeological record (Steele and Bramblett 1988; Buikstra and Ubelaker 1994). Such materials provide a series of essentially unique perspectives on the past through considerations of population biology, population comparisons, population change through time, population health and demography. A brief summary of these perspectives is provided as a way of framing the potential importance of the Buckeye Knoll materials. It is clear that skeletal material provides the only medium through which direct information on a population's physical and biological characteristics (e.g., cranial, post cranial and dental metrics and nonmetrics) can be obtained. This information is used to assess a population's morphological features vis-a-vis other comparative information (Buikstra 1980; Steele and Powell 1993), an approach that has driven a majority of the osteological data collection in the last century. Through statistical comparison of available attributes, we are able to address issues of population evolution that have both chronological and spatial components. These analyses allow for assessment of population affinity, migration patterns and patterns of interaction relating to the broader issue of diachronic population and technological change. In the continental United States, such strategies have been particularly useful in the Midwest where researcher interest and preservation (and consequently larger sample sizes) has proven to be an integral component for understanding not only biological aspects of human populations but also cultural aspects (see studies by J. Buikstra and her colleagues and students centered on sites in the Illinois Valley spanning the Archaic and Mississippian periods - Buikstra 1984; Charles et al. 1988 and many others). Until recently, this approach was the only method for assessing a population's 'genetic' relationships. However, recent developments have initiated a redirected emphasis on the assessment of population affinity through direct access to human genetic material in the form of modern and ancient DNA comparisons (Doran et al. 1986; Smith et al. 1999).

In addition to population genetic issues, an additional focus of modern osteological investigation has been the assessment of population health profiles through assessment of pathological and degenerative changes visible in the skeleton. Identification of specific pathogens, sometimes through differential diagnosis, as well as more recently, identification of surviving bacteria, has also been useful in this approach. More traditional, directly observable features such as linear enamel hypoplasia (evidence of growth disruption in teeth), cribra orbitalia, porotic hyperostosis, and growth arrest lines, as well as actual disease (viral or bacterial based pathogens) states, continue to provide important information of levels of health and disease loads in prehistoric contexts (Buikstra and Cook 1980). Collectively, these approaches have proven useful for developing biological profiles of "success" or "stress" in populations with an emphasis on how "health" relates to cultural and environmental adaptation strategies. This has been one of the critical elements in understanding major shifts in subsistence patterns (hunting-gathering-fishing to agriculture in its various forms) as well as the interaction of such strategies with reconstructed environmental features (see Cohen and Armelagos 1984).

A further focus of skeletal investigation is the assessment of population demographic (or paleodemographic) features. This approach, optimally applied in concert with both biodistance and health related studies as discussed above, minimally requires reliable assessments of age and sex in relatively large skeletal samples (Verano and Ubelaker 1992). For analytical purposes, most researchers feel a minimum of 50 individuals can effectively be used in this approach allowing observations of life expectancy, mortality rates, population growth rates, fertility, generation length, family size and other demographic parameters (Buikstra et al. 1986).

The strategies discussed above are all nondestructive and require little more than the collection of appropriate observable features involving an array of measurement tools and possibly radiographic analyses (x-ray). Some of this information can be collected in the field in relatively short order, although the quality and richness of the results optimally requires a more prolonged laboratory inventory often involving several researchers with specific scientific expertise and their collaboration over several years.

Some techniques of investigation require the destruction of small bone samples (less than 2 grams) and can supplement other nondestructive approaches. Typically these strategies provide an additional range of parameters related to health issues and other features (Lambert et al. 1982). Some of these approaches involve thin section study of the bone itself while a number of others require the chemical/molecular examination of small bone samples - some so small that their extraction can be accomplished with unidentifiable bone fragments (Tuross et al. 1994). The most common techniques involve trace, or major element assessment and stable isotope determination, all of which are standard bone chemistry investigation procedures. Prior studies have focused on the contribution of carbon and nitrogen isotopes for paleodietary reconstruction, however, other elements such as sulfur, strontium, lead, and oxygen have also proven to be useful of diet and residential mobility. In the last 15 years, major advances in extraction and characterization, and direct observation of genetic markers has also added a potentially much more precise method of assessing population genetic relationships, familial connections, and even sex in either poorly preserved or subadult remains where traditional sex assessment criteria are difficult if not impossible (Smith et al. 2000; Tuross 1997; Stone et al. 1996). Increasingly, this approach is targeting biological residues in tooth pulp cavities where the risk of contamination is minimized (Kohlman and Tuross 2000). Most of the genetic studies are

targeting genetic haplotype morphology which are identifiable in the mitochondrial DNA (as opposed to the nucleic DNA). In some samples, no identifiable or analyzable DNA is recoverable due to postdepositional DNA degradation. To date, no viable models for preselecting samples with a higher possibility of DNA preservation are available and the simplest, and most common, strategy, is simply to attempt DNA extraction on any samples under investigation. The larger the sample and the better the preservation, the greater the detail and richness of the interpretive return. It is clear, however, that even in relatively poorly preserved samples analytical rigor and thorough investigation can provide surprising amounts of information. This is particularly true for samples which are unusual or significant with respect to geographic or chronological placement as is the case with Buckeye Knoll.

For optimal analytical richness, all of these techniques can be employed to provide the strongest interpretive framework for detailing the lives of prehistoric populations. In some situations, particularly those involving potential descendant populations, a reduced set of analytical approaches omitting destructive analyses and focusing on nondestructive metric is an effective strategy. The information recovered is quite important and provides the only real method for understanding population affinity, health and demography.

COMPARATIVE DATABASES DESCRIPTIONS

Several databases are used in this discussion to frame the local, regional and national potential of the Buckeye Knoll (41VT98) skeletal sample. These databases have been under development for the last 20 years and provide a variety of chronological and geographic perspectives for comparing skeletal samples such as Buckeye Knoll. All of the databases were initiated as part of a similar comparative effort specifically for FSU archaeological investigations of the Windover site near the east coast of Florida (Windover dates to 7410 14C years BP and is the largest sample of human skeletal material of this antiquity in any of the databases considered).

The four most important databases will be briefly described and then compared in more detail to the Buckeye Knoll materials. These databases include an inventory of North American skeletal samples (NORTH), a craniometric database (CRAN), a postcranial database (PCRAN), and a dental metric database (DENT). A separate database constructed specifically for this study is based on materials from Texas (TEXAS). Details of these databases can be found in Appendix I. Excluding the TEXAS database these datasets minimally contain some kind of information on over 60,000 individuals. While the greatest emphasis has been on the North American database and on the craniometric database, we continue to expand these databases as more information is obtained. Even if an international database was considered the conclusions would be essentially the same and is predicated upon the fact that human skeletal material as old as that from Buckeye Knoll is exceedingly rare regardless of geographic context.

NORTH American Skeletal Inventory Database Comparison

Compared to the North American database containing 42,304 individuals (355 sites) there are only 749 individuals from 61 sites in North America that are as old as those from the Buckeye Knoll site. The Buckeye Knoll Early Archaic sample (n=69 burials) is the third largest sample of pre-6,000 BP material in North America, not just the United States. There are only two US sites with samples as large and as old as those from Buckeye Knoll. One is the Windover site in Florida and the second is Carrier Mills in Illinois (date bp = 6,752, n=159). A third site, Tick Island, also in Florida contains an additional 175 individuals and has a date of 5,240 years BP. Indian Knoll in Kentucky contains over 1,000 individuals and has a reported date of 5,302 years, however, recent information suggests the site is roughly 2,000 years more recent and thus not from the Middle Archaic as has been reported. Most of the sites older than Buckeye Knoll contain between 1 and 5 individuals and only 17 sites contain more than 6 individuals.

In this NORTH sample there are 39 Texas sites containing 4,049 individuals. Of these there are only 7 sites older than 6000 BP which contain 28 individuals (Seminole Sink, n=21; Horn Shelter, n=2; and the Wilson-Leonard II site, Midland, J.C. Putnam, Shifting Sand and Abilene each containing single individuals).

Clearly, samples of this size and antiquity are quite rare; this is particularly obvious when one considers the total number of archaeological sites so far identified in the United States. Skeletal material is found at only a fraction of these sites and the inventory of truly old sites containing skeletal material, is, relatively speaking, vanishingly small. While there are greater numbers of sites in South and Central America and the Old World as old as Buckeye Knoll, most of the samples of this size are from much more recent time periods. For example, in a South American database similar to the NORTH database containing over 6,000 individuals there are only 435 individuals as old as those from the Early Archaic component at Buckeye Knoll and only one site contains more than 69 individuals and dates to 6800 BP. This again emphasizes the importance of the Buckeye Knoll material.

CRAN(ial) Database Comparison

Of the 6,174 individuals in the cranial database coming from 455 sites all over the world there is a clear bias for much more recent materials, and only ten sites produce samples older than 6,000 BP and include information on only 57 individuals. Florida contains the greatest inventory of such materials with 42 individuals from Windover and an additional four from two other Florida sites (Warm Mineral Springs and Little Salt Springs). A small series of specimens of similar antiquity also come from Japan and Australia (fewer than five individuals).

With respect to the craniometric database roughly 1,700 individuals come from only three states Florida (n = 917), Illinois (n=730), and California (n=116). Thirteen other states contribute the remainder of the US samples.

PCRAN (post cranial) Database Comparison

Chronological affiliation of all the other samples in the postcranial database runs from a small series of historic samples to a larger series of prehistoric materials ranging from 120 to 7,400 BP (Windover). The postcranial database contains a large number of individuals from Florida (n=305), Illinois (n=144), and Alabama (n=33) and most of the remaining samples come from east of the Mississippi River. Samples in this database are generally from much more recent intervals, typically the last 2800 years and Windover represents the largest substantially older sample. Almost half the postcranial inventory comes from the last 1600 years. Clearly older samples do exist but often only cranial features are reported. A number of Texas sites, essentially many of those which appear in the cranial database, could be added to the postcranial inventory but the general distribution would remain the same with the majority of available samples coming from the last 2000 years.

DENT(al) Database Comparison

The dental database contains information on over 1500 individuals. The mean radiocarbon date for the entire sample inventory is 2646 14C years BP for the US sample the mean radiocarbon date is 577 14C years BP. Only Windover has dates in excess of 6000 BP, again emphasizing both the importance of collecting the existing sample data as well as the scientific importance of the Buckeye Knoll materials. Excluding Windover the next oldest sites are Bird Island (Florida, with a date of 4570 14C years BP) and Indian Knoll (Kentucky, possibly 5302 BP though this has recently been questioned), and Glacial Kame (Ohio, n=33, 3200 14C years BP). All other US sites in the dental sample are from the last 2000 years. There are actually more Japanese materials in excess of 3000 BP than there are US samples of similar antiquity (excluding the Windover materials). This emphasizes the scientific importance of taking a broad view of the significance of the Buckeye Knoll materials.

TEXAS Database Comparison

As part of a Corps of Engineers inventory of skeletal material from the central US, a number of researchers prepared inventories of existing skeletal samples (Steele et al. 1999; Story et al. 1990; Hester et al 1989 - please see Appendix I for further details of the TEXAS database and details of slight adjustments in geographic organization we have used specifically for this comparison). As noted earlier, diverse sets of information were collected and a subset could be extracted which specifically deals with Texas. This set effort provides the most thorough inventory of Texas skeletal material to date. The Texas inventory includes information on 962 sites. This Texas database potentially contains information on 6,024 individuals. Of this number, however, only 413 sites contain chronological affiliation and have information on 3,107 individuals. The dated materials have a mean date of 1,050 years BP and range in age from historic period to the Horn Shelter material dated to 10,310 14C years BP. The sample comes from 185 Texas counties. Four hundred and twenty seven samples consist of single burials, 124

of the samples consist of two burials and 66 samples consist of three burials. Large samples are relatively rare and only ten sites have more than 50 burials for a total of 1,127 individuals. Of the dated materials in this subset, the mean date is 557 14C years BP and the maximum date is 730 14C years BP. There are 36 sites totaling 173 individuals that are categorized as Archaic. Of these, only nine have more than single burials. A very small number of sites contain more than 100 burials including the Morhiss site (Victoria County, n=250), Ernest Witte site (Austin County, n = 242) and the materials from Loma Sandia (Live Oak County, n=182), and Calle Del Oso (Nueces County, n = 152). All of these sites are important from a comparative perspective given their geographic proximity to Buckeye Knoll and chronological placement. The remainder of the sites with more than 100 individuals are all from the Caddo area and come from Camp, Upshur, Marion and Red River counties which are less proximate both temporally and spatially to Buckeye Knoll. The vast majority of the sites in this survey have not had even the most basic skeletal inventory on the materials recovered. For most of the sites (n=472) there is no evidence of investigation short of noting the presence of human skeletal material or fragments of human skeletal material. For an additional 348 sites, the survey notes that no inventory or study was undertaken, for 104 sites there is some indication of partial inventory and some data collection and for only 30 sites is there an indication that the information would allow comparison to other samples. Clearly, there is a substantial analytical potential with other Texas materials and much of this potential remains untapped due to a relative absence of intensive detailed study of many of the most important samples already excavated. We are in the process of collecting the publications for all reports containing skeletal data and the first step will be to collect the existing information and incorporate it into the databases maintained at Florida State University. Reports of the paleopathological information will also be acquired and will require creation of an additional database structure.

Regional Significance and Potential

In the preceding discussion we attempted to evaluate the significance of the Buckeye Knoll site within the context of the North American continent as a whole. It should be clear from this discussion that the sample represents one of the largest and oldest North American samples found to date, and, therefore, holds great potential in the information it can provide about the earliest inhabitants of the New World. At a more regional level, however, Buckeye Knoll also demonstrates great potential for increasing our understanding of the prehistory of the Texas Gulf Coast through bioarchaeological study. However, a descriptive inventory of a skeletal sample is just that, and the most important considerations are comparative in nature. The purpose of this review is to discuss the comparative samples of skeletal remains from Texas sites to provide some indication of the type and quality of data available for problem-oriented research.

Our compilation of the data produces results similar to those of Steele et al. (1999). We summarize the basic information on sample size and site antiquity for each of the three study regions in Table 1. The samples most germane to this project are located in Region 1 which is represented by 103 samples. The sample sizes are, as expected, extremely variable ranging from isolated finds to samples with 250 individuals. The descriptive data indicate a mean size of 12

individuals; however the much smaller median indicates the average sample size is being leveraged by a few much larger sites. With an estimated 75 individuals, Buckeye Knoll is among the largest skeletal samples for the entire Gulf Coast of Texas and exceeds the 99% confidence bound for sample size for this region. However, as with prior workers, most are undated samples. Of the 103 Coastal Strip samples, only 18 had information on temporal affiliation. Of these 18, the dates range from 180 to 2275 years BP.

The geographic region located just inland of the Coastal Strip (Region 2) consists of 71 sites with sample sizes varying from 1 to 242 individuals. The average number of individuals for all samples was 14, however, as with Region 1, the median value was much lower indicating the typical sample size for this region is much smaller. Again, the Buckeye Knoll sample is beyond the 99% upper confidence bound in terms of sample size. The data for temporal affiliation is extremely limited with only 5 of 71 samples having associated dates which range from 200 to 4875 years BP. The average date of Region 2 samples is 2135 years BP. With an estimated date of 6500 years BP and an estimated sample size of 75 individuals, the Buckeye Knoll site is the oldest and one of the largest skeletal samples found along the Coastal Strip and Plain of Texas. These data alone indicate the absolute scientific importance of the sample.

Despite Buckeye Knoll's uniqueness, it is also evident that several comparative samples exist that would allow thorough and meaningful bioarchaeological comparison. Of the 103 coastal strip samples, 14 of these have sample sizes larger than 20 individuals (Caplen, Harris County Boy's School Cemetery, Ayala, Dietz, Berryman, Calle del Oso, Blue Bayou and Morhiss) totaling 890 burials. The average sample size for these larger samples is 63 individuals, a figure close to the reported estimate for Buckeye Knoll. There are 87 additional sites whose sample sizes are less than 20 individuals that could be included in an aggregate study, an analytical procedure commonly employed in bioarchaelogical research (see for example, Larsen's work on the Georgia Coast and Rose's work in Arkansas). These 87 sites include an aggregate 349 burials. It should be noted that many of the samples located in the Coastal Strip have no recorded sample size information and this 349 individual figure is likely an underestimate.

The adjacent Coastal Plain area (Region 2) also has a substantial representation of comparative samples. We have found 10 sites in the Coastal Plain with sample sizes greater than 20 individuals (Deadman's Tank, Ernest Witte, Goebel, Hitzfelder Cave, Mission San Juan Capistrano, C.H. Chernosky, Mission Espinosa, Loma Sandia, Mason Ranch, and Crestmont) for a total of 780 individuals. The average size of these larger samples is 78, very close to the MNI estimate for Buckeye Knoll. There are 60 additional sites whose sample sizes are less than 20 individuals totaling 230 burials.

In summary, the Coastal Strip and Plain of south Texas offer much in the way of comparative data. Although sample sizes are generally limited and the preservation of the skeletal remains in this region is poor, there are a minimum of 2249 individuals available for comparative research. This large estimate is tempered by sampling and recovery difficulties, a finding expressed by Steele et al. (1999). At the same time, the large size and antiquity of Buckeye Knoll provides an essential component to the earliest phase of human occupation in this area. In essence, the Buckeye Knoll sample would provide the baseline estimate for human biocultural adaptation along the Texas Gulf Coastal plain.

Table 1 Descriptive Statistics for Sample Size and Sample Age for Geographic Regions

	Region 1		Region 2		Region 3	
	No of Burials	DateBP	No. of Burials	Date BP	No. of Burials	Date BP
Number with Data	103	18	71	5	703	391
Minimum	1	180	1	200	1	100
Maximum	250	2275	242	4875	201	10475
Median	3	500	2	2375	1	500
Mean	12	625	14	2135	5	1057
99% Upper of Mean	20	970	27	5849	6	1248
99% Lower of Mean	4	280	3	1600	3	866
Standard Deviation	30	504	38	1804	16	1460

Bibliographic Overview

As part of the literature survey for Texas we have developed a bibliography with slightly over 300 citations generally pertaining to Texas skeletal material. Of these references (all of which are we are in the process of obtaining) 218 appear to contain some type of specific skeletal information. From first hand experience some of these citations merely note the presence of skeletal material and in reality provide little data of comparative utility. We have identified fewer than 30 reports which contain useable comparative data (mostly metrics particularly for crania and long bones). As noted, we are in the process of obtaining these reports in an effort to augment the existing comparative databases. It is also recommended that an important part of any bioarchaeological study of these materials include provisions for acquisition of appropriate comparative data from the most pertinent comparative samples. This will substantially improve the comparative rigor of any investigations.

CONCLUSION

The rarity of materials as old as Buckeye Knoll, and with potentially as many individuals as there appear be, is striking. This is true whether examining Texas, all of North America, or even a brief consideration of the existing international skeletal inventories. Other older samples do exist and larger samples do exist. However, sample as large as and as old as Buckeye Knoll are exceedingly rare regardless of the comparative perspective.

In a comparison incorporating information of some sort on over 60,000 individuals primarily from North America but also including materials from Europe, Japan and Africa, fewer than 900 individuals are as old as those from Buckeye Knoll. This constitutes less than 1.5% of all the materials included in the tabulation. The Buckeye Knoll materials constitute an amazing 8.3% of the materials included in this older data set. It is clear that most skeletal samples regardless of geographic origin, date to much more recent time periods, particularly from the last

2,000 years. Two factors seem both obvious and important in these distributions, one is simply the dramatic increase in global populations in the last 2,000 years. Secondly, the older the material is the more likely it is to disappear from the archaeological record through physical deterioration. Any comparative study should be aimed at amassing information on samples of similar or greater antiquity. This will allow a more useful and accurate assessment of how Buckeye Knoll compares to other early samples regardless of geographic origin. Such an effort would substantially improve our understanding of these early peoples.

It is also clear that there are other, much more recent skeletal samples in Texas, which will provide valuable comparative information. Some of these materials such as those from the Morhiss Mound site and Blue Bayou are geographically close (within a few kilometers) and others are from more distant locations. They can provide an opportunity to consider evolutionary events within a circumscribed geographic area as well as placing the Buckeye Knoll in a broader regional, national and even international perspective.

The older skeletal material from Buckeye Knoll compromises an astonishingly large portion of the North American human remains older than 6000 years BP and is of unparalleled scientific importance in understanding the lives of the some of the earliest peoples of the New World. Human skeletal material provides the only way to expand our understanding of the biology of past peoples and as such is, has been, and will continue to be an important part of the archaeological record.

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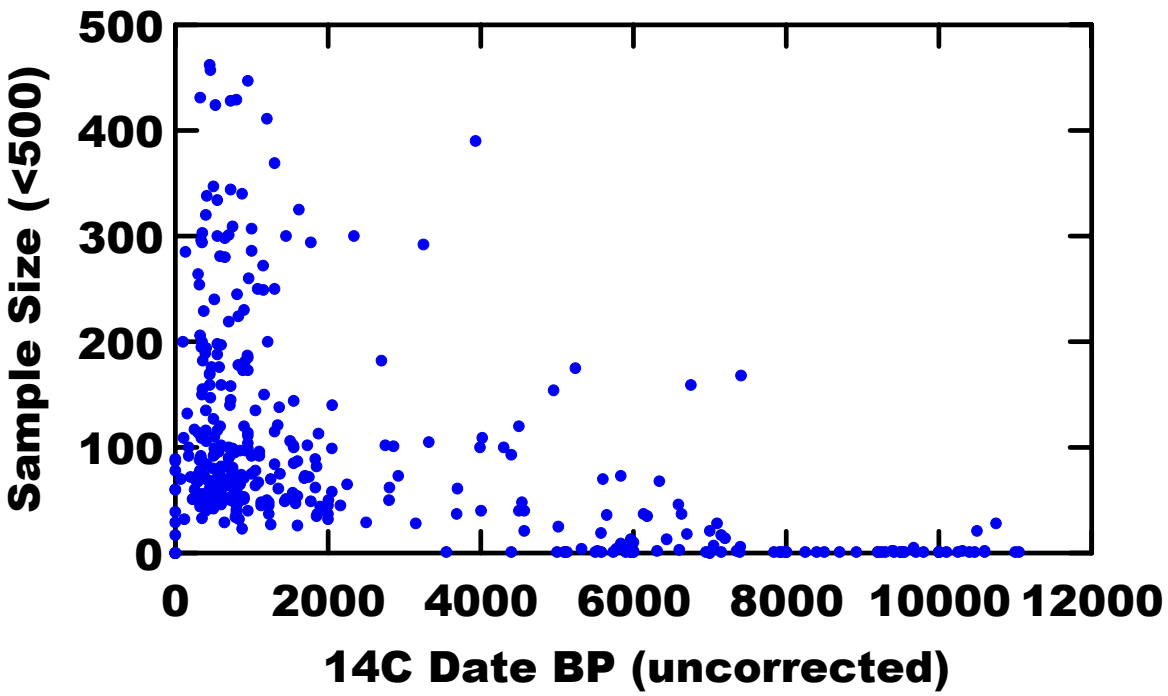
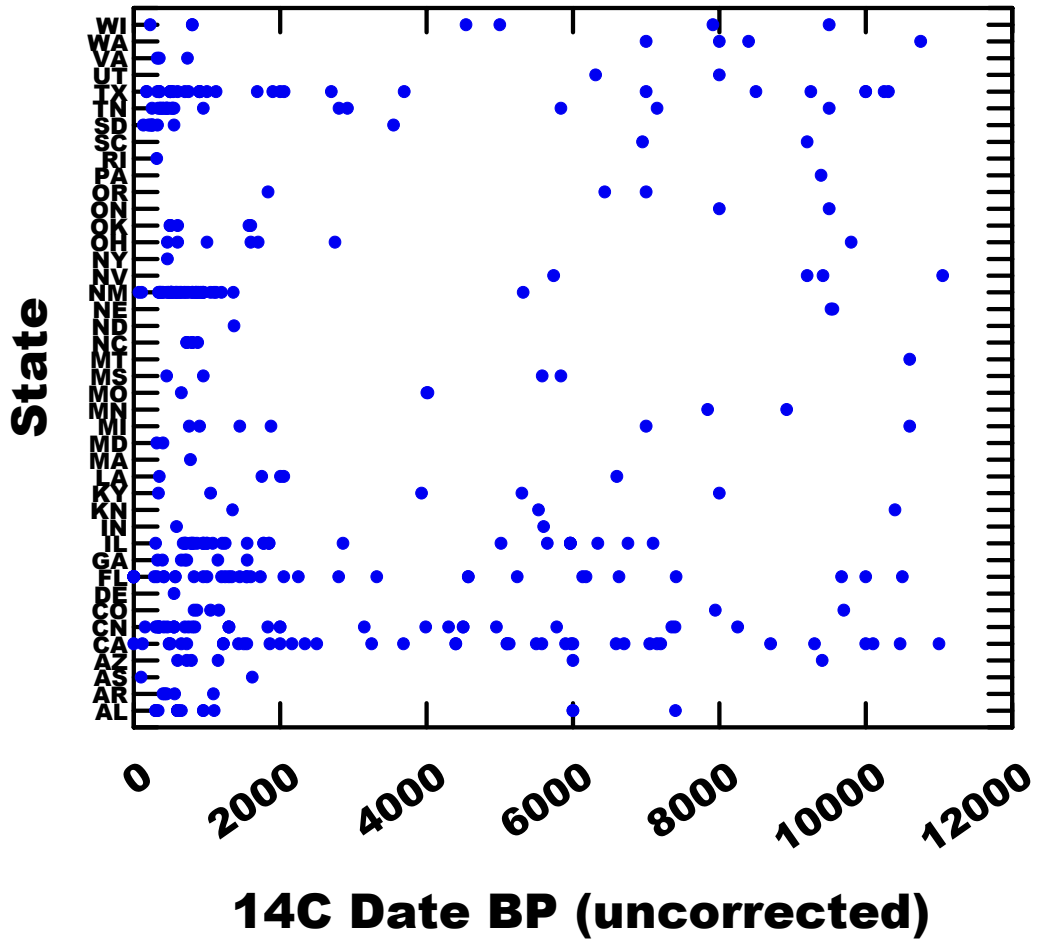


Samples as large as Buckeye Knoll are very rare in general and when the antiquity of the site is considered the scientific importance of the Buckeye Knoll material is even more obvious. This figure includes information on over 45,000 individuals from over 300 sites in North America. This uses the NORTH database discussed previously (including the Canadian materials).

Sample 14C Dates by State



Texas ranks as one of the states with a large number of skeletal samples suitable for osteological investigation. Many of these samples would provide excellent comparative samples with which to frame a variety of important bioarchaeological questions. This illustration also uses the NORTH database (including Canadian materials).